What is claimed is:

1. A method of reducing the size of an input image to a target size by using a quality scaling factor to reduce image quality, wherein the size reduction is effected by a reduction factor estimated from the quality scaling factor and image statistics inherent to the input image, said method comprising the steps of:

selecting a range of quality scaling factors based on the target size;

obtaining a range of reduction factors based on the selected range of quality scaling factors for determining a quality-size relationship;

computing an estimated quality scaling factor corresponding to the target size based on the quality-size relationship;

obtaining an estimated reduction factor based on the estimated quality scaling factor for providing a difference between the target size and the size reduction effected by the estimated reduction factor; and

refining the range of the quality scaling factors for reducing the difference until the difference falls within a predetermined limit.

2. The method of claim 1, wherein a quality-size lookup table is used to select the range of quality scaling factors based on the target size.

3. The method of claim 2, wherein the lookup table is divided into a plurality of bands, and the range of quality scaling factors is selected from one of the bands.

4. The method of claim 1, wherein the image statistics include counts C_i of the number of times a coefficient with magnitude i occurs in the input image.

5. The method of claim 4, wherein the range of reduction factors is computed based on a total bit savings B, where B is given by

$$B = B_m + B_{h_{dc}} + B_{h_{ac}} + B_e$$

$$B_m = \sum_i \lceil \log_2 i \rceil C_i - \sum_i \lceil \log_2 (i.QSF) \rceil C_i = \sum_i (M_i - M_{i.QSF}) C_i = \sum_i D_i C_i$$

$$B_{h_{dc}} = \sum_i H(M_i) C_i - \sum_i H(M_{i.QSF}) C_i = \sum_i \{H(M_i) - H(M_{i.QSF})\} C_i = \sum_i Y_{i_{dc}} C_i ,$$

$$B_{h_{ac}} = \sum_j \sum_i H(16j + M_i) C_{ij} - \sum_j \sum_i H(16j + M_{i.QSF}) C_{ij} = \sum_j \sum_i Y_{ij_{ac}} C_{ij} ,$$

$$B_e = \sum_j H(16j+1) C_{ij} + \sum_j \sum_i H(16j + M_i)[F_{ij} - G_{ij}] = \sum_j \left\{ H(16j+1) C_{ij} + \sum_i H(16j + M_i)[F_{ij} - G_{ij}] \right\}$$

wherein

QSF denotes the quality scaling factor;

M_x is the number of bits required to represent a value of magnitude x;

$H(a)$ is the length of the Huffman codeword representing the value a;

C_{ij} is the count of zero runs of length j terminated by magnitude i;

F_{ij} is the count of zero runs of length j terminated by magnitude i, which commence after a value of magnitude one in the input image; and

G_{ij} is the count of zero runs, which will replace the removed values.

6. A device for reducing the size of an input image to a target size by using a quality scaling factor to reduce image quality, wherein the size reduction is effected by a reduction factor estimated from image statistics inherent to the input image, and wherein a range of quality scaling factors is selected based on the target size for size reduction estimation, said device comprising:

a first computation means, responsive to the range of quality scaling factors, for providing a corresponding range of reduction factors based on the image statistics, said range of quality scaling factors and said corresponding range of reduction factors forming a quality-size relationship;

a second computation means, responsive to the quality-size relationship, for determining an estimated quality scaling factor corresponding to the target size, so as to allow the first computation means to compute an estimated reduction factor for providing a difference between the target size and the size reduction effected by the estimated reduction factor; and

a third computation means, responsive to the difference, for refining the range of the quality scaling factors, thereby changing the range of reduction factors, the quality-size relationship, and the estimated reduction factor, wherein said refining is repeated until the difference falls within a predetermined limit.

7. The device of claim 6, wherein the range of quality scaling factors is selected based on a quality-size lookup table.

8. The device of claim 6, wherein the lookup table is divided into a plurality of bands, and the range of quality scaling factors is selected from one of the bands.

9. The device of claim 6, wherein the image statistics include counts C_i of the number of times a coefficient with magnitude i occurs in the input image.

10. The device of claim 9, wherein the range of reduction factors is computed based on a total bit savings B, where B is given by

$$B = B_m + B_{h_{dc}} + B_{h_{ac}} + B_e$$

$$B_m = \sum_i \lceil \log_2 i \rceil C_i - \sum_i \lceil \log_2 (i.QSF) \rceil C_i = \sum_i (M_i - M_{i.QSF}) C_i = \sum_i D_i C_i$$

$$B_{h_{dc}} = \sum_i H(M_i) C_i - \sum_i H(M_{i.QSF}) C_i = \sum_i \{H(M_i) - H(M_{i.QSF})\} C_i = \sum_i Y_{i_{dc}} C_i ,$$

$$B_{h_{ac}} = \sum_j \sum_i H(16j + M_i) C_{ij} - \sum_j \sum_i H(16j + M_{i.QSF}) C_{ij} = \sum_j \sum_i Y_{ij_{ac}} C_{ij} ,$$

$$B_e = \sum_j H(16j+1)C_{ij} + \sum_j \sum_i H(16j+M_i)[F_{ij} - G_{ij}] = \sum_j \left\{ H(16j+1)C_{ij} + \sum_i H(16j+M_i)[F_{ij} - G_{ij}] \right\}$$

wherein

QSF denotes the quality scaling factor;

M_x is the number of bits required to represent a value of magnitude x;

$H(a)$ is the length of the Huffman codeword representing the value a;

C_{ij} is the count of zero runs of length j terminated by magnitude i;

F_{ij} is the count of zero runs of length j terminated by magnitude i, which commence after a value of magnitude one in the input image; and

G_{ij} is the count of zero runs, which will replace the removed values.

11. A method of modifying a quantization table for reducing the size of a compressed input image to an output image of a target size, wherein the input image is decoded into a partially decompressed image to provide quantized coefficients, which are quantized according to the quantization table, the quantized coefficients including zero and non-zero values, said method comprising the steps of:

determining an estimated scaling factor based on the target size;

scaling the quantization table by the estimated scaling factor for providing a modified quantization table; and

scaling the non-zero coefficients based on the estimated scaling factor for recompressing the partially decompressed image into the output image.

12. The method of claim 11, wherein the estimated scaling factor is a constant floating-point value.

13. The method of claim 11, wherein the compressed input image is a JPEG image.

14. The method of claim 11, wherein the estimated scaling factor, which is utilized for estimating the size of the output image based on the estimated scaling factor, is determined in advance of the recompression.

15. The method of claim 11, wherein the size reduction is related to quality of the output image, said method further comprising the steps of:

selecting a range of quality scaling factors based on the target size; and

obtaining a range of reduction factors based on the selected range of quality scaling factors and image statistics inherent to the input image for determining a quality-size relationship, so as to allow the estimated scaling factor to be determined based on the quality-size relationship.

16. The method of claim 15, further comprising the steps of:

obtaining an estimated size of the output image based on the estimated scaling factor for providing a difference between the target size and estimated size; and

refining the range of quality scaling factors for reducing the difference until the difference falls within a predetermined limit.

17. The method of claim 16, wherein the image statistics include a histogram $(M_i, C_i)$of the quantized coefficients, and the estimated size is computed based on

$$B_m = \sum_i \lceil \log_2 i \rceil C_i - \sum_i \lceil \log_2 (i.QSF) \rceil C_i = \sum_i \left(M_i - M_{i.QSF}\right) C_i = \sum_i D_i C_i$$

where C_i is the count of the number of times a coefficient with magnitude i occurs in the input image, *QSF* is the estimated scaling factor, and B_m a bit saving amount in the size reduction.

18. The method of claim 16, further comprising the step of developing a histogram of the quantized coefficients as the input image is decoded into the partially decompressed image.

19. The method of claim 17, wherein the quantized coefficients include Huffman codewords (*H*), and the estimated size is also computed based on

$$B_{h_{dc}} = \sum_i H(M_i)C_i - \sum_i H(M_{i.QSF})C_i = \sum_i \{H(M_i) - H(M_{i.QSF})\}C_i = \sum_i Y_{i_{dc}} C_i ,$$

wherein M_x is the number of bits required to represent a value of magnitude x, and $H(a)$ is the length of the Huffman codeword representing the value a, and B_{hdc} is another bit saving amount in the size reduction.

20. The method of claim 19, wherein the image statistics include zero run-length values (C_{ij}) and the scaling of non-zero coefficients including the step of Huffman codewords removal, thereby changing the zero run-length values, and wherein the estimated size is further computed based on

$$B_{h_{ac}} = \sum_j \sum_i H(16j + M_i)C_{ij} - \sum_j \sum_i H(16j + M_{i.QSF})C_{ij} = \sum_j \sum_i Y_{ij_{ac}} C_{ij}$$

where C_{ij} is the count of zero runs of length j terminated by magnitude i, and B_{hac} is yet another bit saving amount in the size reduction.